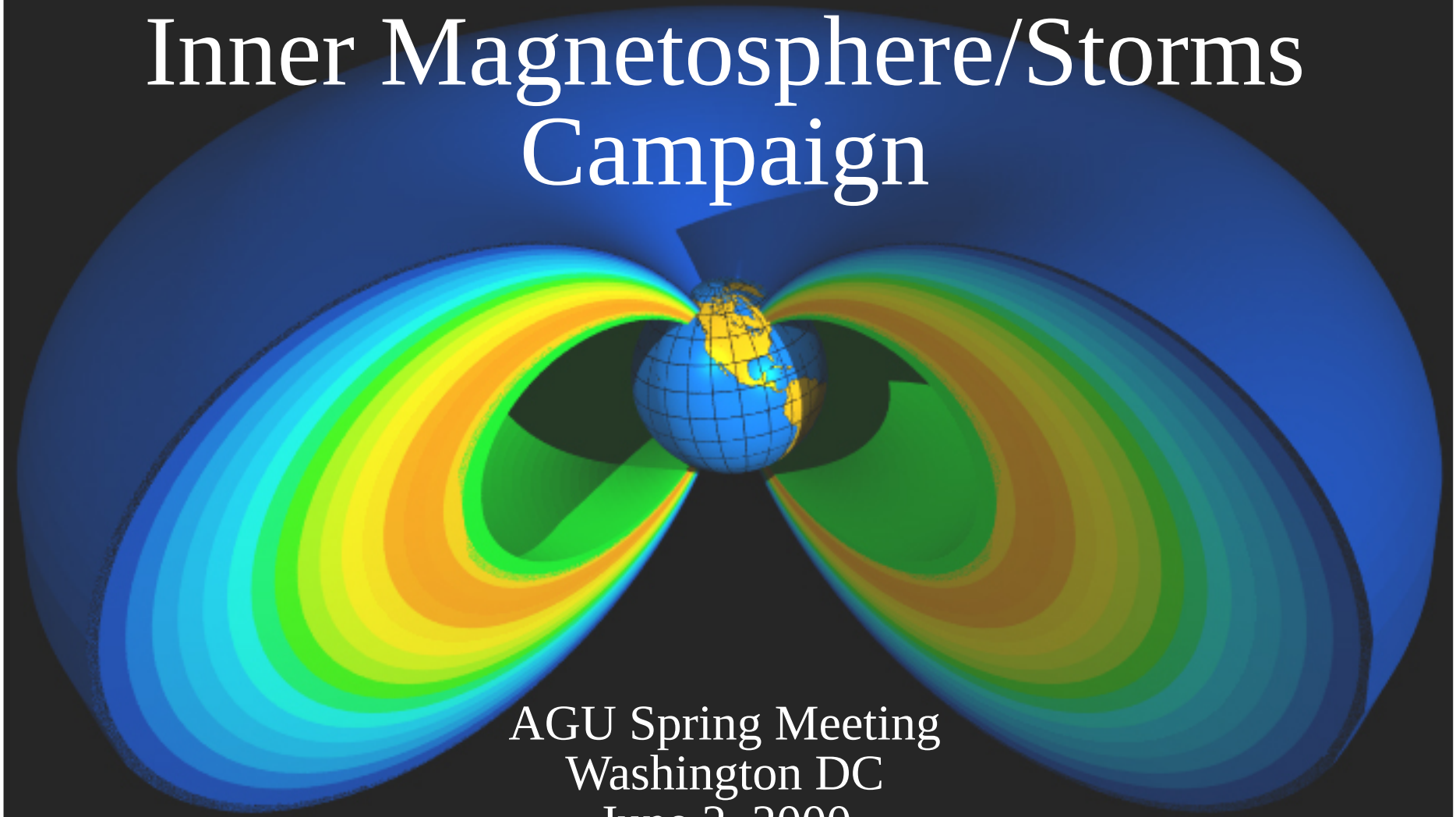
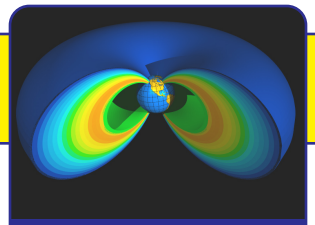
The GEM Inner Magnetosphere/Storms Campaign



AGU Spring Meeting
Washington DC
June 2, 2000



GEM Inner Magnetosphere Storms Campaign

History of the GEM IM-S Campaign

1998 GEM Snowmass Workshop

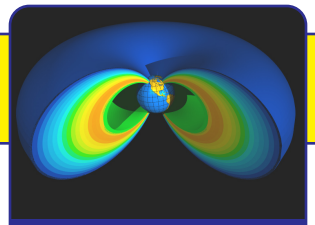
- This was the first “pre-campaign workshop”
- Three working groups were formed (later reduced to two)
- Goals, Strategy, & Issues were selected
- Decision to select ≈2 storms for detailed campaign study

1998 Fall AGU Meeting

- Extensive discussion of criteria for campaign storms and candidate events
- Event selection centered around science themes
- Selection of three campaign storms.

1999 GEM-CEDAR-SHINE Workshop

- June 18, Boulder Colorado - just prior to GEM
- First coordinated exchange of observations, issues, & results



GEM Inner Magnetosphere Storms Campaign

History of the GEM IM-S Campaign

1999 GEM Snowmass Workshop

This was the first official workshop of the campaign

First detailed discussions of the campaign events and related events with an emphasis on *comparative studies*

Refinement of objectives and survey of current state of knowledge in theory, observations, and modeling

1999 Fall AGU Meeting

Updates on studies & progress since June Snowmass meeting

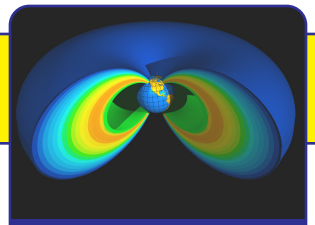
GEM 6-Event Mini-Workshop (Albuquerque, NM)

Informal exchange of data & ideas on SMC & Storm intervals

2000 Spring AGU Meeting (now)

Exchange of scientific results from GEM, CEDAR, & SHINE

Many other scientific meetings now include storm special sessions. e.g. Chapman IAGA, COSPAR, S-RAMP, etc.



GEM Inner Magnetosphere Storms Campaign

Goals and Strategy

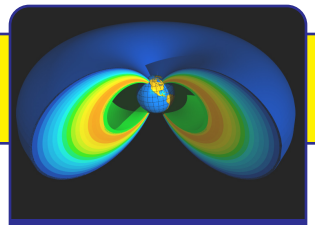
Overall Goal

Specification of the ***scope*** of and ***requirements*** for an Inner Magnetosphere Module for the GGCM

We anticipate that the IM-Module will be composed of a set of coupled and/or interdependent models which supplement the GGCM spine

Strategy

1) Identify key physics issues
2) Conduct individual observational and theoretical studies of key issues
3) Test knowledge and models against selected storm events
4) Extend to new events to test specific processes
5) Make reduced models and/or detailed outputs widely available
6) Couple sets of models in hierarchical and/or interdependent modes



GEM Inner Magnetosphere Storms Campaign

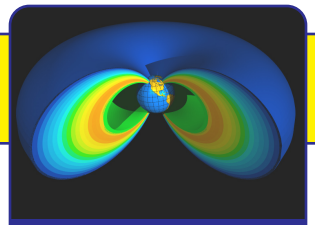
WG1: Plasmasphere & Ring Current

Science Topics and Issues

- Ion Outflowand Magnetosphere-Ionosphere Coupling
- Storm/Substorm Relationship
- Global Electric Field Configuration and Shielding
- Energy Budgets and Partioning
- Ring Current Sources and Losses (including partial ring current)
- Uses, Limiations, and Prediction of Indices
- Pre-existing Plasmasheet Source Populations
- Types of Solar Wind Drivers: e.g. N-S vs S-N, CME vs Vsw

Models

- Several mature Ring Current and Plasmasphere models exist
- New physical processes have been included (e.g. superdense plasmasheet)
- Detailed event models mainly limited by knowledge of sources
- Still need strategy to turn *models* into *modules*



GEM Inner Magnetosphere Storms Campaign

WG2: Radiation Belts

Two Principal Objectives

1) To evaluate the relative contribution of various proposed acceleration processes through theory, modeling, and comparison with data

2) To create time-dependent phase space density profiles of the radiation belts that will more accurately represent their structure and dynamics than fixed energy profiles

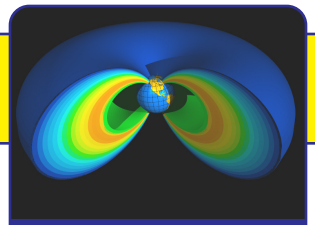
Current State of Knowledge

Observational specification of radiation belt response is not very complete e.g. relationship to storm time ring current intensity, solar wind drivers, etc.

Models are in a state of early development because of incomplete knowledge of physics and specification of sources

Data are available from a relatively large number of satellites but are of varying quality

But...many of the needed observations and theories are available and progress has been rapid



GEM Inner Magnetosphere Storms Campaign

Radiation Belt Theories

Enhanced Radial Diffusion

- Sufficient phase space density at high L-shells
- Physical mechanism, relationship to solar wind drivers, and detailed comparison with observations still lacking
- Salammbo model reproduces global features, lacks detail

Shock Acceleration

- Active in at least some storms, not the major cause of others

Substorm Contributions

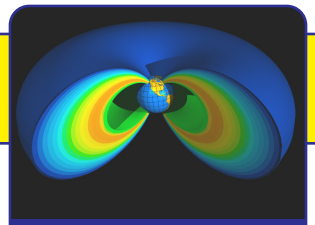
- Evidence that substorm injections produce “seed population”
- General relevance as acceleration/transport mechanism still subject of debate

ULF Wave Resonance

- Good success by pushing particles in MHD wave fields
- Clear enhancement of ULF waves during electron events
- Could produce direct acceleration and/or enhanced diffusion
- General behavior over a large number of events no yet done

VLF Wave Resonance

- Could produce direct acceleration and/or enhanced diffusion
- Detailed theories have been well developed
- Global simulations remain to be done



GEM Inner Magnetosphere Storms Campaign

GEM Storm Events

Suggested Themes

- Comparison of magnetic clouds with N-S vs. S-N IMF Bz
- Comparison of CME and High Speed solar wind drivers
- Comparison of magnetic storms with and w/o relativistic electron enhancements
- Comparison of two recurrent magnetic storms originating from the same solar wind stream structure
- Comparison of a solar minimum and solar maximum storm generated by similar solar wind transients

Criteria

- Modern storms with ISTP satellite coverage
- Good solar wind, magnetospheric, and ground data coverage

Selected Storms (emphasizing comparisons)

May 1997
October 1998
September 1998
(January 1997)